

# Outcome of esophageal cancer in the elderly – systematic review of the literature

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## Abstract

**Introduction:** As the population ages, the number of elderly patients with esophageal cancer increases. Esophageal cancer has a poor prognosis and is associated with decreased life quality.

**Aim:** To review the literature about the outcome of esophageal cancer in patients over 65.

**Material and methods:** Articles published between January 2006 and November 2016 in the PubMed/Medline and ResearchGate databases were reviewed. Nineteen retrospective studies were included.

**Results:** Six thousand seven hundred and twenty-nine patients over 65 were analyzed. Thirty-day mortality ranges from 3.2% to 8.1%. Overall 5-year survival rates range from 0% to 49.2%, and the median survival rate ranges from 9.6 to 108.2 months. The incidence of complications in the surgery group ranges from 27% to 69%. Chemoradiotherapy grade  $\geq 3$  toxicity was observed in 22–36% of patients.

**Conclusions:** Chronological age seems to have little influence on outcome of esophageal cancer. Open esophagectomy seems to be the mainstay of treatment for patients with esophageal cancer, regardless of age. There is still high mortality and morbidity involved in this procedure. To reduce them, some less invasive methods are being trialed.

**Key words:** minimally invasive surgery, chemotherapy, esophageal cancer, outcomes, elderly, esophagectomy.

## Introduction

The progress in medicine, including the prolonged life expectancy, suggests that the number of older elderly patients with esophageal cancer will significantly increase in the coming years. This group of patients is very heterogeneous with regard to co-morbidity and physical reserve, while no clear guidelines of esophageal cancer management for the elderly are available. Regardless of the advance in surgical methods and chemoradiotherapy, the prognosis in this type of cancer remains poor. Despite the high incidence of this type of cancer among the elderly, no review relevant to geriatric patients is available.

## Aim

The current study aimed to review the literature about the outcome of esophageal cancer in patients over 65.

## Material and methods

A systematic review of the literature was conducted using the PubMed/Medline and ResearchGate databases and by screening reference lists of articles. The databases were searched using the phrase “esophageal cancer” AND “elderly”. The titles, abstracts and full-text versions of studies published

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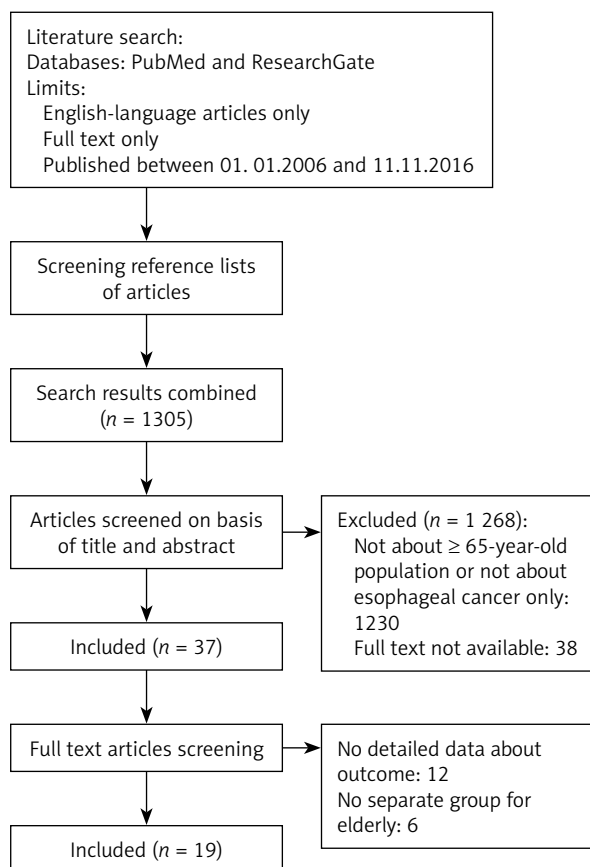


Figure 1. Flow diagram

between January 1, 2006 and November 11, 2016 were sought out for inclusion in the review. Studies of populations aged over 65, treated for esophageal cancer, containing data about outcomes of the treatment (e.g. morbidity, mortality, survival rates), written in English, were included. Case reports, review papers and abstracts were excluded from the review. Finally 19 articles were chosen (Figure 1). Considering 13 studies, authors compared treatment outcome between specified groups of patients. Cummings *et al.* compared endoscopic treatment (ET) and open esophagectomy (OE) groups [1]. Li *et al.* compared OE and minimal invasive esophagectomy (MIE) groups [2]. Abrams *et al.* Tougeron *et al.* and compared OE and chemoradiotherapy (CRT) groups [3, 4]. Tougeron *et al.* presented the results in curative treatment, palliative treatment and best supportive care groups [5]. Tapias *et al.* analyzed 3 groups based on age. Two of them concerned patients aged over 65 years ( $\geq 70$  and  $\geq 80$ ) [6]. Among 7 studies, two groups based on age were compared

(younger vs. elderly) [6–12]. Only the groups consisting of patients  $\geq 65$  years were analyzed.

## Results

Tables I and II include detailed information on population characteristics. Table III presents data on patients' outcomes. All 19 articles were retrospective studies. In total, 6729 patients were included. Most of them were male (4888; 72.64%) while only 23.36% (1841 patients) were female. The authors used four different scales to assess pre-treatment performance status of patients. Seven of them used the American Society of Anesthesiologists (ASA) score, five used the Charlson Comorbidity Index and one used the Eastern Cooperative Oncology Group (ECOG) score. The percentage of patients with comorbidities was in the range 29–84%. One thousand six hundred and thirty-six (51.45%) patients suffered from adenocarcinoma and 1 439 (45.3%) from squamous cell carcinoma. The other cell types were rare ( $n = 105$ ; 3.3%). Four hundred and eighty-two (47.6%) patients had a tumor located in the lower third of the esophagus, 394 (38.9%) in the middle third and 137 (13.5%) in the upper third. Considering all studies which present data about cancer stage, 167 (5.5%), 1565 (51.6%), 760 (25.1%), 445 (14.7%) and 95 (3.1%) patients were diagnosed with tumor stage 0, I, II, III and IV, respectively. Open esophagectomy was the most common treatment method ( $n = 2.023$ ; 30.1%). Five hundred and sixty-nine (8.5%) patients received chemoradiotherapy, 268 (4%) endoscopic treatment and 65 (1%) minimally invasive esophagectomy. Thirty (0.5%) patients received palliative treatment consisting of photodynamic therapy ( $n = 1$ ; 3.3%) or chemotherapy ( $n = 20$ ; 66.7%). 666 (9.9%) patients received best supportive care instead of curative treatment. According to the analyzed publications, 30-day mortality ranges from 3.2% to 8.1%. Overall 5-year survival rates range from 0 to 49.2%, and the median survival rate ranges from 9.6 to 108.2 months. Twelve to seventy percent of patients who had undergone different types of therapy suffered from treatment-related complications. Considering CRT, grade  $\geq 3$  toxicity was observed in 22–36% of patients. The incidence of complications in the surgery group ranges from 27% to 69%. Medical complications occurred more often than surgical ones. The most common were cardiopulmonary ones, such as pneumonia and arrhythmia. The most

**Table I.** List of publications concerning esophageal cancer outcomes in the elderly and the most important data about the methodology of the publications

Authors	Study period [years]	Number of patients (male/female)	Age [years]	Median age [years]	Type of treatment, n (%)	Follow-up period
Cummings <i>et al.</i> (OE group)	1994–2011	893 (691/202)	> 66	74.3 ±5.4	OE	2 years
Liu, Huang <i>et al.</i> (≥ 70 y group)	2001–2012	39 (31/8)	≥ 70	75.1 ±3.6	OE	Until death/until the end of research
Li <i>et al.</i> (OE group)	2005– 2013	58 (44/14)	> 70	72 (70–85)	OE	Until death/until the end of research
Aydin <i>et al.</i>	1998–2010	37 (13/24)	≥ 70	74 ±3.7 (70–83)	OE	Until death/until the end of research
Pultrum <i>et al.</i> (≥ 70 y group)	1991–2007	64 (52/12)	≥ 70	74.5	OE	Until death/until the end of research
Liu, Chen <i>et al.</i> (≥ 70 y group)	1999–2007	29 (22/7)	> 70	75.2 ±3.6	OE	Until death/until the end of research
Kosugi <i>et al.</i> (OE group)	1992–2003	40 (38/2)	≥ 70	77 (75–85)	OE	Until death/until the end of research
Abrams <i>et al.</i> (OE group)	1991–2002	341 (257/84)	≥ 65	nd	OE	Until death/until the end of research
Internullo <i>et al.</i>	1991–2006	108 (76/32)	≥ 76	nd	OE	Until death/until the end of research
Ruol <i>et al.</i> (≥ 70 y group)	1992–2005	159 (124/35)	≥ 70	73.1 (71.6–76.6)	OE	Until death/until the end of research
Ma <i>et al.</i> (≥ 70 y group)	1990–2004	60 (51/9)	≥ 70	73.1 ±3.9	OE	6 months
Mirza <i>et al.</i> (≥ 70 y group)	1996–2010	46 (37/9)	≥ 70	nd	OE	Until death/until the end of research
Li <i>et al.</i> (MIE group)	2005– 2013	58 (44/14)	> 70	72 (70–79)	MIE	Until death/until the end of research
Cummings <i>et al.</i> (ET group)	1994–2011	255 (197/58)	> 66	77.5 ±6.4	ET	2 years
Kikuchi <i>et al.</i> (≥ 75 y group)	2005–2011	13 (11/2)	≥ 70	79 (76–87)	ESD	7 days
Wakui <i>et al.</i>	2003–2008	22 (19/3)	≥ 75	79 (75–85)	CRT	Until death/until the end of research
Kosugi <i>et al.</i> (CRT group)	1992–2003	24 (21/3)	≥ 70	77 (75–85)	CRT	Until death/until the end of research
Abrams <i>et al.</i> (CRT group)	1991–2002	389 (261/128)	≥ 65	nd	CRT	10 years
Tougeron, Di Fiore <i>et al.</i>	1994–2007	109 (90/19)	≥ 70	74.4 ±3.7 (70–88)	CRT	Until death/until the end of research
Anderson <i>et al.</i>	1996–2001	25 (14/11)	65–70 (n = 2) ≥ 70 (n = 23)	77 (66–88)	CRT	Until death/until the end of research

**Table I. Cont.**

Authors	Study period [years]	Number of patients (male/female)	Age [years]	Median age [years]	Type of treatment, n (%)	Follow-up period
Tougeron <i>et al.</i> (curative treatment)	1994–2007	151 (124/27)	≥ 70	74.9 ±4.1	Mucosectomy: 6 (4.0) PDT: 14 (9.3) Surgery: 13 (8.6) CRT: 111 (73.5) RT: 7 (4.6)	Until death/until the end of research
Tougeron <i>et al.</i> (palliative treatment group)	1994–2007	30 (27/3)	≥ 70	74.2 ±4.0	PDT: 1 (3.3) CT: 20 (66.7)	Until death/until the end of research
Tougeron <i>et al.</i> (BSC group)	1994–2007	101 (65/36)	≥ 70	80.0 ±6.6* 78.2 ±5.8**	PDT: 3 (4.3)* CT: 2 (2.9)*	Until death/until the end of research
Tapias <i>et al.</i> (70–79 y group)	2002–2011	124 (99/25)	70–79	73.8 ±2.9	MIE (n = 7) OE (n = 133)	10 years
Tapias <i>et al.</i> (≥ 80 y group)	2002–2011	16 (10/6)	≥ 80	82.2 ±1.6	MIE (n = 0) OE (n = 16)	10 years
Steyerberg <i>et al.</i>	1991–1999	3538 (2470/1068)	≥ 65	nd	Combinations of OE, CT and RT (n = 2973) BSC (n = 565)	Until death/until the end of research

ET – endoscopic treatment (ablation/endoscopic mucosal resection), OE – open esophagectomy, EMR – endoscopic mucosal resection, MIE – minimal invasive esophagectomy, ESD – endoscopic submucosal dissection, CRT – chemoradiotherapy, PDT – photodynamic therapy, RT – radiotherapy, CT – chemotherapy, BSC – best supportive care, \*patients without visceral metastasis/metastases, \*\*patients with visceral metastasis/metastases, nd – no data.

important surgical complications were anastomotic leakage, wound infection and chylothorax.

## Discussion

### Histology type, location and stage

All publications included detailed information about the cancer histology type. Most of them provide information about tumor location and stage. Three studies described connection between cancer histology type and outcome. Cummings *et al.* noted that patients with adenocarcinoma (AC) who underwent open esophagectomy (OE) or endoscopic treatment (ET) had poorer 2-year survival compared to squamous cell carcinoma (SCC) patients (60% vs. 76%;  $p < 0.01$ ) [1]. However, Abrams *et al.* reported that SCC patients were refused surgery more often, but AC patients treated with chemoradiotherapy (CRT) had worse overall and disease-specific survival than the SCC group. They noted that there is a difference in response to CRT between AC and SCC. Considering their results, older patients with AC can benefit from CRT more than SCC patients, but the protocol of chemoradiotherapy is not reported in the study. It is believed that this study may be underpow-

ered to reveal such an advantage of CRT for SCC patients [3]. Anderson *et al.* found no significant difference in 2-year survival between AC and SCC groups treated with CRT consisting of 5-FU, mitomycin and radiation, but this can be explained by the small cohort size (25 patients) [13]. Comparing these results, it is difficult to determine which cancer type has a better prognosis among the elderly, because the conclusions of the studies are conflicting. More advanced tumor stage is a well-known factor of worse prognosis. It has also been confirmed by two studies, which revealed poorer overall survival among elderly patients with a more advanced cancer stage (I/II stage HR = 0.052; 95% CI: 0.005–0.039) [15], (HR = 1.63; 95% CI: 1.32–2.00) [7]. Another study showed that CRT patients diagnosed with stage I had higher disease-specific mortality than the group with stage II tumors. Surprising though it may be, in this study patients with more advanced disease were more likely to receive esophagectomy as a first-line therapy [3]. Two authors found no difference in overall survival considering groups based on tumor stage [4, 8]. However, this was not elaborated on in the discussion. Aydin *et al.* found that histology type, tumor location and tumor stage were not prognos-

**Table II.** List of publications concerning esophageal cancer outcomes in the elderly and the most important data about the population

Authors	Histology, <i>n</i> (%)			Tumor stage, <i>n</i> (%)					Tumor site		
	SCC	AC	Other	0	I	II	III	IV	L1/3	M1/3	U1/3
Cummings <i>et al.</i> (OE group)	261 (29.23)	632 (70.77)	0 (0)	88 (9.9)	805 (90.1)	0 (0)	0 (0)	0 (0)	nd	nd	nd
Liu, Huang <i>et al.</i> (≥ 70 y group)	30 (76.9)	9 (23.1)	0 (0)	0 (0)	0 (0)	20 (51.3)	14 (35.9)	5 (12.8)	17 (43.6)	16 (41.0)	6 (15.4)
Li <i>et al.</i> (OE group)	58 (100)	0 (0)	0 (0)	0 (0)	3 (5.2)	30 (51.7)	25 (43.1)	0 (0)	6 (10.3)	42 (72.4)	10 (17.2)
Aydin <i>et al.</i>	27 (73.0)	6 (16.2)	4 (10.8)	0 (0)	4 (10.8)	19 (51.4)	14 (37.8)	0 (0)	18 (48.6)	17 (46.0)	2 (5.4)
Pultrum <i>et al.</i> (≥ 70 y group)	8 (13)	56 (87)	0 (0)	0 (0)	11 (17)	25 (52)	25 (39)	3 (5)	60 (94)	4 (6)	0 (0)
Liu, Chen <i>et al.</i> (≥ 70 y group)	26 (89.7)	3 (10.3)	0 (0)	0 (0)	0 (0)	14 (48.2)	11 (37.9)	4 (13.8)	13 (44.8)	11 (37.9)	5 (17.2)
Kosugi <i>et al.</i> (OE group)	40 (100)	0 (0)	0 (0)	0 (0)	11 (27.5)	15 (37.5)	11 (27.5)	3 (7.5)	18 (45.0)	19 (47.5)	3 (7.5)
Abrams <i>et al.</i> (OE group)	94 (27.5)	213 (62.5)	34 (10.0)	0 (0)	177 (51.9)	164 (48.1)	0 (0)	0 (0)	nd	nd	nd
Internullo <i>et al.</i>	26 (24)	80 (74)	2 (1.8)	6 (5.5)	29 (26.8)	25 (23.1)	29 (26.7)	19 (17.5)	93 (86.1)	13 (12)	2 (1.8)
Ruol <i>et al.</i> (≥ 70 y group)	77 (48.4)	77 (48.4)	5 (3.2)	5 (3.2)	20 (12.7)	71 (44.2)	50 (31.9)	11 (7.0)	94 (59.1)	37 (23.3)	28 (17.6)
Ma <i>et al.</i> (≥ 70 y group)	53 (88.3)	4 (6.7)	3 (5.0)	1 (1.7)	2 (2.2)	9 (15.0)	45 (75.0)	3 (5.0)	16 (26.7)	32 (53.3)	10 (16.7)
Mirza <i>et al.</i> (≥ 70 y group)	45 (97.83)	1 (2.17)	0 (0)	nd	nd	nd	nd	nd	nd	nd	nd
Li <i>et al.</i> (MIE group)	58 (100)	0 (0)	0 (0)	0 (0)	4 (6.9)	31 (53.4)	23 (39.7)	0 (0)	8 (13.8)	44 (75.9)	6 (10.3)
Cummings <i>et al.</i> (ET group)	78 (31)	177 (69)	0	60 (23.5)	195 (76.5)	0 (0)	0 (0)	0 (0)	nd	nd	nd
Kikuchi <i>et al.</i> (≥ 75 y group)	13 (100)	0 (0)	0 (0)	nd	nd	nd	nd	nd	1 (8)	9 (69)	3 (23)
Wakui <i>et al.</i>	22 (100)	nd	nd	0 (0)	3 (13.64)	6 (27.27)	12 (54.55)	1 (4.55)	nd	10 (46)	nd
Kosugi <i>et al.</i> (CRT group)	24 (100)	0 (0)	0 (0)	0 (0)	1 (4.2)	14 (58.3)	7 (29.2)	2 (8.4)	3 (12.5)	15 (62.5)	6 (25.0)
Abrams <i>et al.</i> (CRT group)	209 (53.7)	141 (36.3)	39 (10.0)	0 (0)	232 (59.6)	157 (40.4)	0 (0)	0 (0)	nd	nd	nd
Tougeron, Di Fiore <i>et al.</i>	77 (70.6)	28 (25.7)	4 (3.7)	0 (0)	2 (1.8)	50 (45.9)	46 (42.2)	6 (5.5)	52 (47.7)	36 (33.3)	21 (19.3)
Anderson <i>et al.</i>	13 (52)	12 (48)	0 (0)	0 (0)	0 (0)	8 (32)	17 (68)	0 (0)	nd	nd	nd
Tougeron <i>et al.</i> (curative treatment)	103 (70.1)	44 (29.9)	0 (0)	0 (0)	24 (15.9)	61 (40.4)	51 (33.8)	7 (4.6)	80 (60.0)	44 (29.1)	27 (17.9)
Tougeron <i>et al.</i> (palliative treatment group)	17 (56.7)	12 (40.0)	1 (3.3)	0 (0)	0 (0)	0 (0)	0 (0)	30 (100)	19 (63.3)	9 (30.0)	2 (6.7)
Tougeron <i>et al.</i> (BSC group)	63 (67.02)	27 (28.72)	4 (4.26)	0 (0)	3 (4.3)	7 (10.1)	18 (26.1)	1 (1.4)	52 (51.49)	33 (32.67)	16 (15.84)

Table II. Cont.

Authors	Histology, n (%)			Tumor stage, n (%)					Tumor site		
	SCC	AC	Other	0	I	II	III	IV	L1/3	M1/3	U1/3
Tapias <i>et al.</i> (70–79 y group)	15 (12.1)	100 (80.7)	9 (7.2)	7 (6.2)	34 (30.1)	29 (25.7)	43 (38.1)	0 (0)	nd	nd	nd
Tapias <i>et al.</i> (≥ 80 y group)	2 (12.5)	14 (87.5)	0 (0)	0 (0)	5 (35.7)	5 (35.7)	4 (28.6)	0 (0)	nd	nd	nd
Steyerberg <i>et al.</i>	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

L1/3 – lower third, M1/3 – middle third, U1/3 – upper third, SCC – squamous cell carcinoma, AC – adenocarcinoma, nd – no data.

tic factors for treatment-related complications and mortality, but only 37 patients were included in their study [14].

### Comorbidities

Performance status was assessed to evaluate individual risk of therapy, and to decide the treatment approach. Ruol *et al.* noted that, compared to the younger population, the elderly were excluded from surgery more often because of comorbidities (40% vs. 20%) [9]. Two papers mentioned “decreased functional body reserves” as a reason why elderly patients were considered unfit for surgery, but no detailed definition of decreased body reserve and assessment of frailty syndrome was reported [7, 15]. Three studies noted a significant impact of comorbidities on long-term survival [4, 7, 16]. Liu *et al.* identified poorer pulmonary function and limited functional reserve as a risk factor for higher mortality and morbidity after OE [7]. Among the articles, the usefulness of performance status scores was discussed. Tougeron *et al.* have shown that the Charlson score can be used as a prognostic factor for median overall survival (13.9 ± 3.6 months Charlson score ≤ 2 vs. 4.1 ± 2.6 months Charlson score > 2; HR = 2.1, 95% CI: 1.0–4.5;  $p = 0.046$ ). Patients with a score ≥ 1 who underwent chemoradiotherapy were more likely to experience grade 2 or more toxicity (76.5% vs. 51.2%,  $p = 0.02$ ) and chemotherapy delay (66.7% vs. 39.5%,  $p = 0.01$ ) [4]. Steyerberg *et al.* described poorer survival in patients with a Charlson score ≥ 2 [16]. Pultrum *et al.* used the ASA score to assess patients, and did not consider it as a prognostic factor, but found that cardiovascular comorbidity among the elderly was a risk factor for postoperative comorbidity [8]. Tougeron *et al.* found no prognostic value of the Charlson score [5].

### Effect of age

Eight studies, concerning surgical treatment, compared populations based on age. There was no study on chemoradiotherapy (CRT) comparing such groups. Only three papers have shown a significant difference in outcomes. Median survival described in one study differed in elderly and younger patients (151–306 days vs. 350–944 days) [16]. Moreover, there was a significant difference in the overall complication rate (53.6% (< 70 years) vs. 62.1% (70–79 years) vs. 87.5% (≥ 80 years);  $p = 0.011$ ) [6]. Another study showed a significant increase in cardiac and pulmonary complications in patients aged ≥ 70 (pulmonary: 43.3% vs. 28.1%;  $p = 0.01$ ; cardiac: 28.3% vs. 19.8%,  $p = 0.001$ ), but no difference in the overall complication rate [10]. Age ≥ 70 was associated with longer intensive care unit stay with a median of 7 days (range: 1–64) in elderly versus younger patients, with a median of 3 days (range: 1–56) (95% CI: –9.95 to –1.86;  $p = 0.005$ ) [8]. The report of Tapias *et al.* was the only study to show that elderly patients treated with less intensive radiotherapy or chemoradiotherapy had longer overall survival than younger patients (15.8 months vs. 13.7 months). The authors suggest that it can support the thesis that the tumor growth and metastatic spread become slower with aging. Considering the advantages of advanced age, another study showed decreased incidence of anastomotic stricture in the elderly group (OR = 0.99;  $p = 0.574$ ). The authors postulated that the attenuated inflammatory response in the elderly leads to less collagen deposition and fibrosis [6]. Liu *et al.* observed longer survival time in the elderly treated with less intensive chemotherapy following esophagectomy in comparison to younger ones, but the results were statistically insignificant (median survival time 15.8 m vs. 13.7 m;  $p = 0.44$ ). The other

**Table III.** List of publications concerning esophageal cancer outcomes in the elderly and the most important data about the outcomes

Authors	Pre-treatment comorbidity assessment score	Mortality, n (%)	All complications/toxicity, n (%)	Overall survival rates (%)				Median overall survival [months]	Recurrent disease, n (%)
				1 year	2 years	3 years	5 years		
Cummings <i>et al.</i> (OE group)	Charlson/Deyo comorbidity index	36 (4) <sup>2</sup>	265 (30)	nd	71 (AC) 60 (SCC)	nd	nd	nd	139 (16)
Liu, Huang <i>et al.</i> (≥ 70 y group)	nd	3 (7.7) <sup>5</sup>	18 (46.1)	nd	33.3	0	nd	15.8	nd
Li <i>et al.</i> (OE group)	nd	5 (8.6) <sup>5</sup>	35 (60.3)	nd	nd	nd	nd	22 ±3.4	nd
Aydin <i>et al.</i>	nd	3 (8.1) <sup>1</sup>	16 (43.2)	70.3	nd	31	21.4	28.7	6 (16.2)
Pultrum <i>et al.</i> (≥ 70 y group)	ASA	7 (11) <sup>3</sup>	44 (69)	70	nd	nd	33	26 (range: 0–199)	27 (42)
Liu Chen <i>et al.</i> (≥ 70 y group)	ECOG	3 (10.3) <sup>4</sup>	15 (51.7)	nd	20	3	0	12.1 (95% CI: 8.6–15.6)	nd
Kosugi <i>et al.</i> (OE group)	ASA	2 (5) <sup>1</sup>	26 (65.0)	77.5	nd	37.3	24.0	108.2 (range: 32.5–138.9)	nd
Abrams <i>et al.</i> (OE group)	Charlson/Klabunde comorbidity index	24 (7.7) <sup>1</sup>	nd	nd	nd	53.1	44.9	nd	nd
Internullo <i>et al.</i>	ASA	8 (7.4) <sup>5</sup>	56 (51.9)	nd	nd	nd	35.7	28.5 (range: 0.1–149.5)	(33.3)
Ruol <i>et al.</i> (≥ 70 y group)	ASA	3 (1.9) <sup>1</sup> 3 (1.9) <sup>4</sup>	78 (49.1)	nd	nd	nd	35.4	17.9 (range: 9.2–44.4)	nd
Ma <i>et al.</i> (≥ 70 y group)	nd	2 (3.3) <sup>4</sup>	nd	nd	nd	nd	nd	nd	nd
Mirza <i>et al.</i> (≥ 70 y group)	ASA	nd	nd	nd	nd	nd	nd	10.8 (range: < 1 month to 8.3 years)	21 (45.65)
Li <i>et al.</i> (MIE group)	nd	2 (3.4) <sup>5</sup>	22 (37.9)	nd	nd	nd	nd	39 ±8.9	nd
Cummings <i>et al.</i> (ET group)	Charlson/Deyo comorbidity index	nd	30 (12)	nd	84 (AC) 76 (SCC)	nd	nd	nd	32 (13)
Kikuchi <i>et al.</i> (≥ 75 y group)	ASA	0 (0) <sup>5</sup>	13 (27)	nd	nd	nd	nd	nd	nd
Wakui <i>et al.</i>	nd	4 (18.2) <sup>5</sup>	14 (70)	44.3 ±10.8	34.5 ±10.4	15.9 ±10.8	nd	23.8 (range: 8.3–53.6)	11 (55)
Kosugi <i>et al.</i> (CRT group)	ASA	5 (21) <sup>6</sup>	nd	60.9	nd	17.4	11.6	72.5m (range: 12.4–95.3)	1 (4.1)
Abrams <i>et al.</i> (CRT group)	Charlson/Klabunde comorbidity index	nd	nd	nd	nd	23.9	13.9	nd	nd

Table III. Cont.

Authors	Pre-treatment comorbidity assessment score	Mortality, n (%)	All complications/toxicity, n (%)	Overall survival rates (%)				Median overall survival [months]	Recurrent disease, n (%)
				1 year	2 years	3 years	5 years		
Tougeron, Di Fiore <i>et al.</i>	Charlson score	2 (2.2) <sup>5</sup>	62 (56.9)	56.9		19.27	6.4	15.2 ±2.8	31 (28.4)
Anderson <i>et al.</i>	Charlson score	0 (0) <sup>5</sup>	9 (36)	80	64	nd	nd	35 (3–66)	nd
Tougeron <i>et al.</i> (curative treatment)	Charlson score	nd	nd	nd	nd	nd	nd	17.8 ±1.5* 5.5 ±2.0**	35 (23.17)
Tougeron <i>et al.</i> (palliative treatment group)	Charlson score	nd	nd	nd	nd	nd	nd	6.7 ±2.1	7 (23.33)
Tougeron <i>et al.</i> (BSC group)	Charlson score	nd	nd	nd	nd	nd	nd	5.5 ±2.0* 1.8 ±0.4**	18 (17.82)
Tapias <i>et al.</i> (70–79 y group)	nd	4 (3.2) <sup>1</sup> 7 (6.1) <sup>3</sup>	77 (62.1)	nd	nd	nd	41.7	nd	nd
Tapias <i>et al.</i> (≥ 80 y group)	nd	1 (6.3) <sup>1</sup> 2 (14.3) <sup>3</sup>	14 (87.5)	nd	nd	nd	49.2	nd	nd
Steyerberg <i>et al.</i>	Charlson score	nd	nd	42	24	nd	11	9.63 (95% CI: 9.2–10)	nd

<sup>1</sup>30-day mortality, <sup>2</sup>60-day mortality, <sup>3</sup>90-day mortality, <sup>4</sup>in-hospital mortality, <sup>5</sup>no data, <sup>6</sup>treatment-related mortality, \*patients without visceral metastasis/metastases, \*\*patients with visceral metastasis/metastases, nd – no data.

studies also found no significant difference in mortality, morbidity or long-term survival in younger and older group [8, 9, 11, 17].

### Methods of treatment

Due to the retrospective character of studies, little is known about the process of therapeutic decision making. Two studies have shown a tendency for less invasive procedures to be conducted in older than in younger patients. Older age was associated with more frequent use of ET instead of OE [1]. Moreover, elderly patients were more likely to undergo transhiatal than transthoracic esophagectomy compared to the younger group [18]. Carcinoma *in situ* was considered as an indication for ET [1, 5]. One study considered advanced disease (≥ T3 and unresectable nodes) as a reason for refusing surgery [18]. Although the management of esophageal cancer in the elderly population is still discussed, esophagectomy seems to be the mainstay of treatment for patients with esophageal cancer [12]. Regardless

of development of surgical techniques, there are still high mortality and morbidity involved in this procedure [5, 12]. Accordingly, some less invasive methods of treatment such as minimal invasive esophagectomy (MIE) or endoscopic treatment are being trialed [1, 2, 11]. Chemoradiotherapy alone is also considered a promising treatment method in some cases [5, 13, 16]. Cummings *et al.* observed decreased mortality (HR = 0.51; 95% CI: 0.36–0.73) and 2-year survival (HR = 0.61; 95% CI: 0.45–0.85) in the ET group (compared to OE), but only patients with early stage tumor (0, I) were operated on in such a way. Li *et al.* reported a significantly lower rate of overall complications in the MIE group than in the OE group (37.9 vs. 60.3,  $p = 0.016$ ). In this study patients with stages I and II were included.

Kikuchi *et al.* observed no mortality in their study on endoscopic submucosal dissection, but it also pertains only to early stages of cancer (tumor diameter < 2 cm) and can be explained with non-invasive character of the procedure [11].



## Quality of life

Unfortunately, no study has addressed the quality of life. Some complications such as esophageal stricture, vocal cord palsy or a need for tracheostomy can provide some data on this matter, but they cannot substitute detailed psychological analysis [19, 20].

## Conclusions

Chronological age seems to have little influence on outcome of esophageal cancer treatment [7, 9, 11, 12, 14, 17]. Therefore, advanced age should not be considered as a contraindication for esophagectomy, but the risk should be evaluated individually. Currently, no study takes into consideration detailed geriatric assessment identifying the frailty state of the patient. There is also no study showing outcomes reported by patients that would present to the physicians the older patients' view of the treatment process. Therefore, there is a great need for well-designed prospective studies including full geriatric assessment.

## Conflict of interest

The authors declare no conflict of interest.

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